Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx
https://doi.org/10.1016/j.ijom.2017.11.018, available online at https://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Orthognathic Surgery

Postoperative nausea and vomiting after oral and maxillofacial surgery: a prospective study

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M. Dobbeleir, J. De Coster, W. Coucke, C. Politis: Postoperative nausea and vomiting after oral and maxillofacial surgery: a prospective study. Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx.

Abstract. Postoperative nausea and vomiting (PONV) is one of the most unpleasant experiences after surgery. It reduces patient satisfaction and also increases hospital costs due to longer hospitalizations. The aim of this prospective study was to determine whether orthognathic surgery is associated with more PONV than less invasive maxillofacial surgery. Three hundred and eight patients aged 8–87 years who underwent maxillofacial surgery were included. The PONV score, based on the Apfel score, was calculated preoperatively. PONV occurred in 142 (46.1%) patients during the first three postoperative days; these patients were further categorized as having postoperative nausea (PON) and/or postoperative vomiting (POV). PON was most frequent after orthognathic surgery to the mandible (75%), and POV was most frequent after maxillary surgery, including bimaxillary surgery, Le Fort I osteotomy, and surgically assisted rapid palatal expansion (SARPE) (43.1%). There was a small significant relationship between the preoperative PONV score and the incidence of PONV: patients experienced more PONV when the PONV score calculated preoperatively was higher. The incidence of PONV after orthognathic surgery was very high compared with the incidence after dental extractions and other minor surgeries. Further investigation is required to establish a strategy to reduce PONV after orthognathic surgery.

Key words: PONV; nausea; vomiting; complications; orthognathic surgery; anaesthesia; prospective study; anti-emetic.

Accepted for publication

Postoperative nausea and vomiting (PONV) is a common and frequent complication after general anaesthesia[1]. PONV leads to longer hospitalizations, thereby increasing healthcare costs, and affected patients often have negative feelings related to the surgery and anaesthesia[2]. PONV is defined as nausea, retching, or vomiting during the first 2 days after surgery[3]. The reported incidence varies between 20% and 30%, but it can be as high as 80% in high-risk patients[3–5]. Fur-

0901-5027/000001+05

Please cite this article in press as: Dobbeleir M, et al. Postoperative nausea and vomiting after oral and maxillofacial surgery: a prospective study, *Int J Oral Maxillofac Surg* (2018), https://doi.org/10.1016/j.ijom.2017.11.018

thermore, patients who undergo maxillofacial surgery are more predisposed to PONV, especially after orthognathic surgery to the maxilla[6]. This can be explained by swallowed blood, an altered diet, and hypotension in the perioperative period[1].

Unfortunately, there are only a small number of major studies demonstrating a higher incidence of PONV after oral and maxillofacial surgery. Perrott et al. found PONV to be the most common of the postoperative complications following oral and maxillofacial surgery[6]. A high incidence of PONV in orthognathic surgery to the mandible and/or maxilla was found by Silva et al.[7]. No other studies have reported the incidence of PONV after specific interventions in oral and maxillofacial surgery.

The purpose of this study was to identify the specific interventions in the field of oral and maxillofacial surgery that are more related to PONV. Risk factors for PONV can be categorized into those associated with the preoperative period, the perioperative period, and the postoperative period, as outlined below.

Preoperative risk of PONV

The identification of patients at risk of PONV remains a challenge[8]. Apfel et al. developed a simplified risk score to predict PONV[9–11]. The Apfel score assesses the following: (1) female sex (this is a major risk factor and triples the risk of PONV); (2) history of motion sickness or PONV (this indicates general susceptibility to PONV); (3) smoking status (being a non-smoker roughly doubles the risk of PONV, although the underlying pathophysiology remains unknown); (4) postoperative opioid use (PONV shows a dose-dependent association with opioid use)[8–13].

A screening score based on the Apfel score was used in a previous study to calculate the risk of PONV preoperatively using different variables: each patient undergoing surgery was asked about their age (<50 years = 1, ≥50 years = 0), sex (female = 1, male = 0), history of motion sickness and/or PONV (yes = 1, no = 0), and their smoking status (non-smoker = 1, smoker = 0). The PONV score was then calculated based on these patient-specific variables, along with the predicted duration of the operation (<60 min = 0, ≥60 min = 1), predicted use of perioperative and postoperative opioids (yes = 1, no = 0), and the type of surgery (ophthalmological, orthopaedic, laparoscopic, otolaryngological, and other). These patients undergoing general anaesthesia were found to have scores ranging from 0.1 to 0.8[11].

Perioperative risk of PONV

General anaesthesia is associated with an 11-fold increased risk of PONV, which is frequently caused by the emetic properties of volatile anaesthetics and the opioids administered[13–15]. In addition, the type of surgery is an independent risk factor for PONV[1,4,16]. If the risk of PONV is high and general anaesthesia is required, the use of intravenous propofol can reduce the incidence of PONV[17,18]. Adequate perioperative intravenous fluid administration also reduces PONV. This may be related to a reduction in the release of serotonin, which decreases in response to the reduction in systolic blood pressure that is associated with intestinal hypoperfusion[19–21].

Postoperative risk of PONV

Opioids are commonly used postoperatively after general anaesthesia[4]. Some researchers have suggested that pain is a primary factor that induces nausea in the recovery unit[22]. Furthermore, PONV is frequently associated with pain postoperatively[23]. At the University Hospitals Leuven, the synthetic opioid piritramide is the opioid most often used for postoperative pain therapy.

Materials and methods

This prospective study included 308 patients aged 8 to 87 years who were due to undergo general anaesthesia for maxillofacial surgery. All surgical procedures were performed at the University Hospitals Leuven. Patients undergoing oral and maxillofacial surgery at the hospitals who agreed to participate and signed the informed consent form were included. If the patient was younger than 18 years of age, a parental signature was obtained. Patients under the age of 8 years and patients who were unable to communicate were excluded. Patients who underwent major oncological surgery were also excluded from the protocol, due to their postoperative stay in the intensive care unit. The study was approved by the Ethics Committee of the University Hospitals Leuven. The maxillofacial surgeries were categorized based on bleeding risk, as follows[24–27]: maxillary osteotomy surgery (bimaxillary surgery (BIMAX)/surgically assisted rapid palatal expansion (SARPE)/Le Fort I; $n = 72$), bilateral sagittal split osteotomy (BSSO; $n = 32$), temporomandibular joint (TMJ) surgery ($n = 12$), dental extraction ($n = 113$), and other minor surgery ($n = 79$) (Table 1).

A PONV score was calculated for every patient preoperatively; this score varied between 0.1 and 0.8 and was based on sex, history of motion sickness and PONV, smoking status, the use of perioperative and postoperative opioids, type of

Table 1. Distribution of the interventions to specific surgical groups.

Intervention	Group	Number
Arthroscopy	TMJ surgery	11
BIMAX	BIMAX/SARPE/Le Fort I	35
Biopsy	Other minor surgery	1
Osteotomy, block	Other minor surgery	1
Orthodontic bone anchors	Other minor surgery	5
Bone augmentation	Other minor surgery	19
BSSO	BSSO	32
Cryotherapy	Other minor surgery	1
Cystectomy	Other minor surgery	2
Eminectomy	TMJ surgery	1
Tooth extraction	Dental extraction	39
Frenectomy	Other minor surgery	2
Dental implants	Other minor surgery	3
Le Fort I osteotomy	BIMAX/SARPE/Le Fort I	6
Orbital floor fracture repair	Other minor surgery	1
Oral tumour resection	Other minor surgery	1
SARPE	BIMAX/SARPE/Le Fort I	31
Sialoendoscopy	Other minor surgery	1
Tooth transplantation	Other minor surgery	11
Soft tissue surgery	Other minor surgery	1
Vestibuloplasty	Other minor surgery	1
Removal of osteosynthesis material	Other minor surgery	29
Wisdom tooth removal	Dental extraction	74

BIMAX, bimaxillary surgery; BSSO, bilateral sagittal split osteotomy; SARPE, surgically assisted rapid palatal expansion; TMJ, temporomandibular joint.

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surgery, age, and duration of surgery[11]. The specific anaesthesia protocol for each patient was based on this PONV score. Postoperatively, each patient remained in the recovery unit until discharge by the anaesthesiologist. Depending on the type of surgery, the patients then went home or were hospitalized.

An online questionnaire was completed by each participant 3 days after surgery, and the completed questionnaire was e-mailed to the Department of Oral and Maxillofacial Surgery, University Hospitals Leuven. Each patient was assigned a specific number in order to ensure patient privacy. The questionnaire asked six questions: (1) Do you have a history of postoperative nausea or vomiting? (2) Did you have symptoms of nausea and vomiting before surgery? (3) Did you suffer from nausea after surgery? (4) Did you vomit after surgery? (5) Did you ask for medicine to treat nausea and vomiting postoperatively? (6) Did the medicine reduce the nausea or vomiting? The patients answered these questions using multiple choice responses.

The data analysis was performed by a certified statistician. A P-value of <0.05 was considered statistically significant.

Results

Of note, it was found that all patients who experienced postoperative vomiting (POV) also experienced postoperative nausea (PON). Of the 308 patients, 21.1% ($n = 65$) experienced POV and PON, while another 25% ($n = 77$) experienced PON alone. Thus, overall, 46.1% of the patients experienced PON and 21.1% experienced POV. When the data were assessed for each surgery type separately, PON appeared to differ between surgery types. PON was experienced by 41.7% of patients who underwent TMJ surgery, 28.3% who underwent dental extraction, 75% who underwent BSSO, 72.2% who underwent BIMAX/SARPE/Le Fort I osteotomy, and 36.7% who underwent other minor surgeries (Table 2). Furthermore, 43.1% of the patients who underwent BIMAX/SARPE/Le Fort I osteotomy, 31.2% who underwent BSSO, 9.7% who underwent dental extraction, 8.3% who underwent TMJ surgery, and 15.2% who underwent other minor surgeries experienced POV (Table 3).

The BIMAX/SARPE/Le Fort I group and the BSSO group had significantly higher PON rates than the other minor surgery group ($P = 0.0003$ and $P = 0.0055$, respectively) and the dental extraction group ($P = 0.0001$ and $P = 0.0002$, respectively).

Table 2. Patients who experienced postoperative nausea (PON) according to surgical group.

Surgical group	Nausea		
	No	Yes	Yes %
Other minor surgery	50	29	36.7
BIMAX/SARPE/Le Fort I	20	52	72.2
BSSO	8	24	75
Dental extraction	81	32	28.3
TMJ surgery	7	5	41.7

BIMAX, bimaxillary surgery; BSSO, bilateral sagittal split osteotomy; SARPE, surgically assisted rapid palatal expansion; TMJ, temporomandibular joint.

Table 3. Patients who experienced postoperative vomiting (POV) according to surgical group.

Surgical group	Vomiting		
	No	Yes	Yes %
Other minor surgery	67	12	15.2
BIMAX/SARPE/Le Fort I	41	31	43.1
BSSO	22	10	31.2
Dental extraction	102	11	9.7
TMJ surgery	11	1	8.3

BIMAX, bimaxillary surgery; BSSO, bilateral sagittal split osteotomy; SARPE, surgically assisted rapid palatal expansion; TMJ, temporomandibular joint.

The P-values for the other between-group comparisons can be found in Table 4.

A similar pattern was observed for the POV group, although there was no significant difference between the BSSO group and the other minor surgery group. Significance was found for BIMAX/SARPE/Le Fort I versus other minor surgery ($P = 0.0031$), for BIMAX/SARPE/Le Fort I versus dental extraction ($P = 0.0001$), and for BSSO versus dental extraction ($P = 0.0348$). The P-values for the other between-group comparisons can be found in Table 5.

General anaesthesia was usually induced with propofol and maintained with volatile anaesthetic gas, or induced and maintained with target-controlled infusion (TCI) with propofol. General anaesthesia was maintained with desflurane for 62 patients (20.1%), sevoflurane for 161 patients (52.3%), and TCI with propofol for 85 patients (27.6%). PON was observed in 45.2% of the patients who received desflurane, in 37.3% who received sevoflurane, and in 63.5% who received TCI with propofol. A significant difference in PON was seen between the sevoflurane group and the TCI with propofol group ($P = 0.0005$); PON was significantly less observed when anaesthesia was maintained with sevoflurane than when maintained with TCI with propofol.

When TCI with propofol was administered, 27 patients (31.8% of the patients who were maintained with TCI propofol) had POV. When desflurane was used, 11 patients (17.7% of those maintained with desflurane) had POV, and when sevoflurane was used, 27 patients (16.8% of those maintained with sevoflurane) had POV.

The relationship between the preoperative PONV score and the incidence of PONV was analyzed using a generalized linear model for binomial data and a logit link. PONV was considered a numerical variable in this case. Borderline significance was found ($P = 0.0502$), with a coefficient of 1.1083 (Fig. 1).

Discussion

Silva et al. described a high incidence of PONV after orthognathic surgery[7]. In the present study, a very high incidence of PONV after both mandibular and maxillary surgery was found. Before this prospective analysis was started, it was predicted that there would be a higher incidence of PONV after maxillary surgery and a lower incidence of PONV after

Table 4. Differences in postoperative nausea (PON) between the indicated surgical groups.

Surgical groups	Estimate	P-value
Other minor surgery vs. BIMAX/SARPE/Le Fort I	−1.5002	0.0003[a]
Other minor surgery vs. BSSO	−1.6433	0.0055[a]
Other minor surgery vs. dental extraction	0.384	0.7421
Other minor surgery vs. TMJ surgery	−0.2083	0.9976
BIMAX/SARPE/Le Fort I vs. BSSO	−0.1431	0.9985
BIMAX/SARPE/Le Fort I vs. dental extraction	1.8842	0.0001[a]
BIMAX/SARPE/Le Fort I vs. TMJ surgery	1.292	0.2703
BSSO vs. dental extraction	2.0273	0.0002[a]
BSSO vs. TMJ surgery	1.4351	0.2714
Dental extraction vs. TMJ surgery	−0.5922	0.8791

BIMAX, bimaxillary surgery; BSSO, bilateral sagittal split osteotomy; SARPE, surgically assisted rapid palatal expansion; TMJ, temporomandibular joint.
[a] Statistically significant, $P < 0.05$.

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Table 5. Differences in postoperative vomiting (POV) between the indicated surgical groups.

Surgical groups	Estimate	*P*-value
Other minor surgery vs. BIMAX/SARPE/Le Fort I	−1.4402	0.0031[a]
Other minor surgery vs. BSSO	−0.9313	0.3352
Other minor surgery vs. dental extraction	0.5073	0.7916
Other minor surgery vs. TMJ surgery	0.6781	0.9724
BIMAX/SARPE/Le Fort I vs. BSSO	0.5089	0.7945
BIMAX/SARPE/Le Fort I vs. dental extraction	1.9475	0.0001[a]
BIMAX/SARPE/Le Fort I vs. TMJ surgery	2.1183	0.2872
BSSO vs. dental extraction	1.4386	0.0348[a]
BSSO vs. TMJ surgery	1.6094	0.6048
Dental extraction vs. TMJ surgery	0.1708	0.9999

BIMAX, bimaxillary surgery; BSSO, bilateral sagittal split osteotomy; SARPE, surgically assisted rapid palatal expansion; TMJ, temporomandibular joint.

[a] Statistically significant, $P < 0.05$.

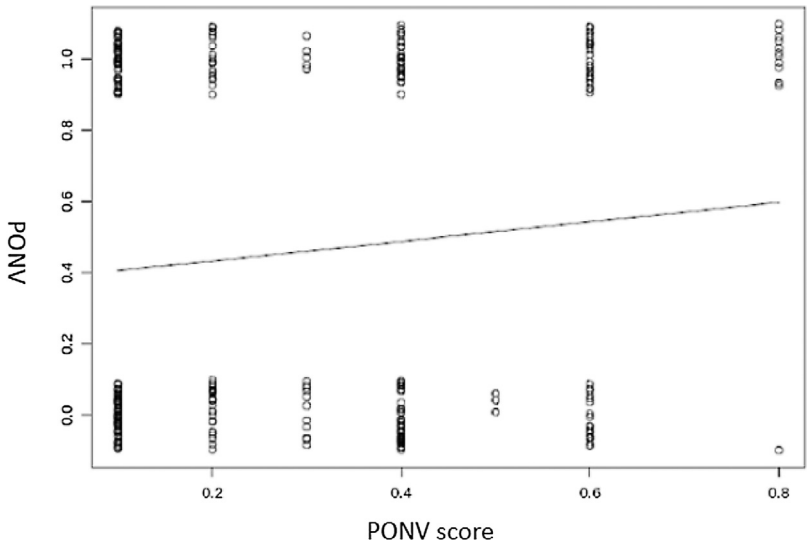

Fig. 1. Scatter plot of postoperative nausea and vomiting (PONV) cases versus PONV scores. PONV cases were coded as '1'; non-PONV cases were coded as '0'. In order to show the density of the observations, jitter was added to the figure by adding a small random value to the PONV code values. The line on the figure shows the values as predicted by a general linear mixed model.

mandibular osteotomy. This prediction was based on the higher perioperative and postoperative blood loss in maxillary surgery and on the smaller bleeding risk in mandibular osteotomy[24,25]. It was not expected that so many patients (75%) would report PON after mandibular osteotomy. The factors that increase the incidence of PONV have been described by Apfel et al.[8,11], and include age, female sex, a history of motion sickness or PONV, non-smoking status, opioid use, duration of surgery, and type of surgery.

In this analysis, the PONV score was a relatively good predictor of PONV after oral and maxillofacial surgery; however, a higher correlation between the PONV score and the resulting PONV was expected. The lower correlation was probably due to the effective anti-emetic protocol used at the University Hospitals Leuven, where the type of anaesthesia is based on the patient's PONV score. If a patient has a high preoperative PONV score, the anaesthesiologist will mainly adjust the maintenance protocol to use TCI anaesthesia and avoid the use of volatile anaesthetic gas[15]. Furthermore, the attending anaesthesiologist administers anti-emetic drugs based on the preoperatively calculated PONV score. When the PONV score is $\leq$0.2, dexamethasone is administered. When the PONV score is between 0.2 and 0.6, ondansetron is added. Finally, when the score is >0.6, the anaesthesiologist combines dexamethasone and ondansetron together with dehydrobenzperidol. However, in some cases, anaesthesia is not performed or anti-emetics are not administered based on the PONV score; rather, in a few patients these decisions are based on the personal preference of the attending anaesthesiologist.

This study also identified differences in PON and POV between the indicated surgical groups: a significant difference in PONV was found between the different types of maxillofacial surgery, especially when maxillary surgery (BIMAX/SARPE/Le Fort I osteotomy) and BSSO procedures were compared to the other different types of maxillofacial surgery.

Despite the avoidance of inhalation anaesthesia and the use of TCI with propofol when a patient had a high preoperative PONV score, the incidences of nausea (63.5%) and vomiting (31.8%) were higher in the TCI group. This suggests that blood loss during surgery has a major impact on PONV. Unfortunately, projected intraoral blood loss is not yet included in the preoperative PONV score. Nevertheless, anaesthesiologists from the University Hospitals Leuven mainly use TCI with propofol during orthognathic surgery.

In the post-anaesthesia care unit (PACU), nurses treat PONV and pain as quickly as possible. If the patient's profile warrants it, the attending anaesthesiologist may decide to treat PONV with an extra dose of anti-emetics. A prescription for anti-emetic medication was given to each patient at discharge in case of PONV at home.

Many variables such as sex, history of motion sickness and PONV, smoking status, the use of perioperative and postoperative opioids, age, and the duration of surgery are already taken into account in the PONV score. However, because oral and maxillofacial surgery is not yet included in the PONV score, the main goal of the present study was to determine the specific types of procedure in oral and maxillofacial surgery that contribute more to PONV. Further studies with larger numbers of patients will be required to determine whether sex, history of motion sickness and PONV, smoking status, the use of perioperative and postoperative opioids, age, and the duration of surgery have a specific impact on PONV in oral and maxillofacial surgery.

This study found a high incidence of PONV after oral and maxillofacial surgery, especially after orthognathic surgery, despite the use of an effective anti-emetic protocol at the study institution. Mandibular osteotomies (BSSO procedures) showed the highest incidence of PON, while bimaxillary surgery, SARPE, and Le Fort I osteotomy showed the highest incidence of POV. Since maxillary surgery and BSSO procedures induced significantly more PONV than the other maxillofacial procedures, these could be included as a parameter in

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the calculation of the Apfel score. A small but statistically significant relationship was detected between the preoperatively calculated PONV score and the incidence of PONV. PONV is one of the most unpleasant and frequent complications after surgery. It reduces patient satisfaction and increases hospital healthcare costs. Thus, it remains important to develop strategies to minimize PONV after orthognathic surgery.

Funding

This study received no funding.

Competing interests

The authors have no conflicts of interests to disclose.

Ethical approval

The Ethics Committee of the University Hospitals Leuven, Belgium approved this study (2015; #S-57988).

Patient consent

Written informed consent was obtained from all patients or their guardians prior to participation in the study.

References

1. Kovac AL. Prevention and treatment of postoperative nausea and vomiting. *Drugs* 2000;**59**:213–43.
2. Keyes M. Management of postoperative nausea and vomiting in ambulatory surgery: the big little problem. *Clin Plast Surg* 2013;**40**:447–52.
3. Pierre S, Whelan R. Nausea and vomiting after surgery. *Contin Educ Anesth Crit Care Pain* 2013;**13**:28–32.
4. Watcha MF. Postoperative nausea and emesis. *Anesthesiol Clin North Am* 2002;**20**:709–22.
5. Conway B. Prevention and management of postoperative nausea and vomiting in adults. *AORN J* 2009;**90**:391–413.
6. Perrott DL, Yuen JP, Andresen RV, Dodson TB. Office-based ambulatory anesthesia: outcomes of clinical practice of oral and maxillofacial surgeons. *J Oral Maxillofac Surg* 2003;**61**:983–95.
7. Silva AC, O'Ryan F, Poor DB. Postoperative nausea and vomiting (PONV) after orthognathic surgery: a retrospective study and literature review. *J Oral Maxillofac Surg* 2006;**64**:1385–97.
8. Neufeld SM, Newburn-Cook CV. What are the risk factors for nausea and vomiting after neurosurgery? A systematic review. *Can J Neurosci Nurs* 2008;**30**:23–34.
9. Apfel CC. Evidence-based analysis of risk factors for postoperative nausea and vomiting. *Br J Anaesth* 2012;**109**:742–53.
10. Roberts GW, Bekker TB, Carlsen HH, Moffatt CH, Slattery PJ, McClure AF. Postoperative nausea and vomiting are strongly influenced by postoperative opioid use in a dose-related manner. *Anesth Analg* 2005;**101**:1343–8.
11. Apfel CC, Läärä E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. *Anesthesiology* 1999;**91**:693–700.
12. Weilbach C, Rahe-Meyer N, Raymondos K, Weissig A, Scheinichen D, Piepenbrock S. Postoperative nausea and vomiting (PONV): usefulness of the Apfel-score for identification of high risk patients for PONV. *Acta Anaesth Belg* 2006;**57**:361–3.
13. Sinclair DR, Chung F, Mezei G. Can postoperative nausea and vomiting be predicted. *Anesthesiology* 1999;**91**:109–18.
14. Apfel CC, Stoecklein K, Lipfert P. PONV: a problem of inhalational anaesthesia? *Best Pract Res Clin Anaesthesiol* 2005;**19**:485–500.
15. Apfel CC, Kranke P, Katz MH, Goepfert C, Papenfuss T, Rauch S, Heineck R, Greim CA, Roewer N. Volatile anaesthetics may be the main cause of early but not delayed postoperative vomiting: a randomized controlled trial of factorial design. *Br J Anaesth* 2002;**88**:659–68.
16. Apfel CC, Kranke P, Roewer N. Patient selection and presentation of antiemetic outcome variables. *Anesthesiology* 1999;**90**:1789–90.
17. Deballi P. The use of propofol as an antiemetic. *Int Anesthesiol Clin* 2003;**41**:67–77.
18. Kim SI, Han TH, Kil HY, Lee JS, Kim SC. Prevention of postoperative nausea and vomiting by continuous infusion of subhypnotic propofol in female patients receiving intravenous patient- controlled analgesia. *Br J Anaesth* 2000;**85**:898–900.
19. Elgueta MF, Echevarría GC, De la Fuente N, Cabrera F, Valderrama A, Cabezón R, Muñoz HR, Cortinez LI. Effect of intravenous fluid therapy on postoperative vomiting in children undergoing tonsillectomy. *Br J Anaesth* 2013;**110**:607–14.
20. Muchatuta NA, Peach MJ. Management of postoperative nausea and vomiting: focus on palonosetron. *Ther Clin Risk Manag* 2009;**5**:21–34.
21. Heshmati F, Hasani Afshar A, Mahoori A, Zeinali MB, Abbasivash R. High intravenous fluid therapy prevents post-tonsillectomy nausea and vomiting. *Iran J Med Sci* 2004;**29**:72–4.
22. Chia YY, Kuo MC, Liu K, Sun GC, Hsieh SW, Chow LH. Does postoperative pain induce emesis? *Clin J Pain* 2002;**18**:317–23.
23. Andersen R, Krohg K. Pain as a major cause of postoperative nausea. *Can Anaesth Soc J* 1976;**23**:366–9.
24. Politis C. Life-threatening haemorrhage after 750 Le Fort I osteotomies and 376 SARPE procedures. *Int J Oral Maxillofac Surg* 2012;**41**:702–8.
25. Piñeiro-Aguilar A, Somoza-Martín M, Gandara-Rey JM, García-García A. Blood loss in orthognathic surgery: a systematic review. *JOral Maxillofac Surg* 2011;**69**:885–92.
26. Moghadam HG, Caminiti MF. Life-threatening hemorrhage after extraction of third molars: case report and management protocol. *J Can Dent Assoc* 2002;**68**:670–4.
27. Moenning JE, Bussard DA, Lapp TH, Garrison BT. Average blood loss and the risk of requiring perioperative blood transfusion in 506 orthognathic surgical procedures. *J Oral Maxillofac Surg* 1995;**53**:880–3.

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